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HOWARD LUCAS

1885—1963

A Biographical Memoir by

WILLIAM G. YOUNG AND SAUL WINSTEIN

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Howard J. Rucker

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March 7, 1885–June 22, 1963

BY WILLIAM G. YOUNG
AND SAUL WINSTEIN

HOWARD J. LUCAS was born to William W. Lucas and Marian Curtis Lucas in Marietta, Ohio, on March 7, 1885. He attended Ohio State University for both undergraduate and graduate work, receiving the B.S. degree in 1907 and the M.A. degree in 1908. Many years later, in 1953, he was awarded an Honorary D.Sc. degree by that institution. He became a Fellow in chemistry at the University of Chicago in 1909-1910, working toward a Ph.D. degree. At this point he was forced to leave school, owing to the death of his father, and he became Assistant Chemist in the U.S. Department of Agriculture (1910-1913). From 1913 to 1915 he served as Instructor at Throop College of Technology (which later became the California Institute of Technology). He was promoted to Associate Professor of Organic Chemistry in 1915 and to Professor in 1940. He served as Visiting Professor of the University of Hawaii in 1953 and Visiting Professor at Ohio State University in 1954-1955. Although he became Emeritus Professor of Organic Chemistry at the California Institute of Technology in 1955, he continued actively in research until shortly before his death.

Lucas was interested in the profession of chemistry from the time he joined the American Chemical Society in 1909.

He became active in the Southern California section of the society about 1916, serving on many committees until he became chairman of the section in 1931-1932. He helped promote an unusual high school chemistry contest, which is still an important activity of the section today.

Professor Lucas was honored by election to the National Academy of Sciences in 1957, after having been the second recipient of the American Chemical Society's award in Chemical Education, sponsored by the Scientific Apparatus Makers Association in 1953. The purpose of this award is to recognize outstanding contributions to chemical education. These recognitions came late in his career, primarily because his education was interrupted by the death of his father and because he joined the California Institute of Technology while it was in its infancy. He spent the better part of ten years working with several other talented people developing a curriculum which was based on extremely high standards and close working relationships between professor and student. As Cal Tech progressed, so did Lucas's opportunities to secure graduate students of high calibre. Although he was the only organic chemist on the staff in the early days, his influence and inspiration in his particular field caused many talented students to choose organic chemistry, despite the great attractiveness of the field of physical chemistry, at that time under Arthur A. Noyes.

Lucas's outstanding skills as an educator were devoted to bringing out the best efforts inherent in the individual as a student and a researcher in the field. His example of doing research himself, particularly in cooperation with his students in those fields of organic chemistry which could take advantage of the skills usually associated with physical chemistry, produced talented men who continued laying the foundation of what is now known as physical organic chemistry. All of the men who were associated with him as students

considered him to be an excellent teacher. He gave one the feeling that he was sincerely interested in imparting knowledge and developing the student's laboratory skill. However, to quote one of Lucas's most successful students, "One needed to serve as a teaching assistant to obtain a real insight into Lucas, the teacher." All were amazed at the care that went into setting up and testing lecture demonstrations. The underlying principle of Professor Lucas's teaching method was to "get the student to think" and to "conduct experiments with the utmost accuracy and with carefully purified chemicals."

In trying to get the student to think, Professor Lucas emphasized the physical chemical side of organic chemistry. In so doing he did much to simplify organic chemistry for the student, tying it in with the chemistry the student already knew, especially at Cal Tech. Since there was no text available for this approach, Lucas wrote his own text, *Organic Chemistry,* which became a classic in the field. This book was one of the first to recognize the value of electronic interpretations in the field of organic chemistry, clearly relating organic chemistry to modern chemical theory.

The research program carried forward by Professor Lucas provided a substantial fraction of the theoretical basis of present-day organic chemistry. He did some of the very first research in physical organic chemistry.

When H. J. Lucas began his research, the electron-pair description of the covalent bond had just been recognized; he made the first clear application of the idea of electron displacement in molecules to the interpretation of the behavior of organic substances. He correlated the direction of addition of unsymmetrical reagents to olefins and other properties of molecules, such as acid strength, with relative electronegativities of substituent groups. He made a start on the more complex problem of electron displacement in aromatic

substances and contributed to the understanding of aromatic substitution. His contributions and ideas were incorporated in the comprehensive electronic theory of organic reactions later developed mainly by the English.

Much of Professor Lucas's work involved unsaturated compounds. He and his students prepared pure cis- and trans-2-butenes and 2-pentenes. They carried out a comprehensive series of investigations which elucidated the kinetics and mechanisms of hydration of olefinic and acetylenic materials. Lucas's interest in the interpretation of the behavior of π-electron-containing materials led him to a study of the ability of olefins to complex with acceptor species such as silver ion and mercuric ion. This work and its interpretation anticipated by some ten years the more recent general concept of "π-complexes."

A good deal of Lucas's work dealt with the stereochemistry of materials with two asymmetric centers, such as glycols, epoxides, aminoalcohols, and dihalides, and the stereochemistry of their reactions. The work on substitution reactions of such materials led to the now generally recognized participation of neighboring functional groups in substitution reactions by way of cyclic intermediates such as ethylene bromonium and chloronium ions.

An interesting sideline carried along by Professor Lucas was qualitative organic analysis. Besides teaching this subject in an extremely fundamental manner, he made occasional original contributions to the field. For example, his hydrochloric acid-zinc chloride reagent for differentiation of primary, secondary, and tertiary alcohols is commonly known among organic chemists as the "Lucas reagent."

Professor Lucas died June 22, 1963, in Pasadena, California. He had been in poor health for some time because of a heart ailment.

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KEY TO ABBREVIATIONS

Ind. Eng. Chem., Anal. Ed. = Industrial and Engineering Chemistry, Analytical Edition
Ind. Eng. Chem. = Industrial and Engineering Chemistry (formerly Journal of Industrial and Engineering Chemistry)
J. Am. Chem. Soc. = Journal of the American Chemical Society
Org. Syn. = Organic Syntheses

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